

Time Savings and Higher Efficiency Practices With Electronic Hardware Designs

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Top electronic hardware design performers hit design budgets 82% more frequently than average companies¹. Top performers save \$26k in design re-spins over lagging companies².

Electronic design projects are composed of hardware design (H/W) and software design. This paper focuses on how to save time, reduce overhead and reduce the number of design revisions during hardware development - by improving the design-development process (schematic design, Printed Circuit Board (PCB) layout, PCB libraries, PCB fabrication, PCB assembly and test).

Executive Summary

Major Finding

PCB Library problems (i.e. PCB circuit pattern doesn't match the designed component shape, or doesn't match the schematic) are the cheapest direct expense in the H/W design process, but the largest indirect expense if done wrong. Top performing companies make sure internal (or external) process flows for PCB library shapes have at least 3 steps of quality control (1-checklist for all library shape parameters, 2-second person review of the final shapes and 3-DFM analysis with software that uses an outside reference shape).

Significant Findings

Outsourcing PCB Layout saves time and/or reduces revisions when:

- I. It involves new technology that your company has little experience with.
- II. Extra man hours are needed for PCB layout (project schedule compression).
- III. Schedules need more than one designer working on the job.

Outsourcing New Product Introduction PCB Assembly saves time/money when:

- I. New technology (SMT, PCB, components, etc.) requires special SMT machines or processes.
- II. PCB complexity involves more components than internal resources can handle.
- III. Custom tooling (NRE) is required that exists at outsourcing contract manufacturer.

Recommendations

- I. Use **DFx** (Design for PCB fabrication, library, assembly or test) often and early in the H/W design process. Valor® DFx is an impartial 3rd party check for library parts.
- II. Carefully **match customer requirements** with internal or external design skills. Look for certifications that match the customer's needs (i.e. medical, wireless, MIL SPEC, export controlled, rigid-flexible PCBs, high volume consumer experience, high speed designs, etc.).
- III. If scheduling is tight with internal resources, **outsource to experts** with the right tools. Use many milestones to insure designs are on schedule and correct.

Details

PCB Libraries

Those little schematic symbols, or footprints on the PCB, look so simple. Yet, they are the foundation for the success, or failure, of the entire project. The direct labor cost for creation of those electronic shapes is between \$3 for resistors (or capacitors) to \$300+ for large new FPGAs. But, if they are not created 100% correct, components will not fit on the PCB and new PCBs may have to be ordered (at a minimum cost of \$2,000) or new components ordered (costs will vary). Schedules will slip by 1 to 5 days. New tooling may have to be ordered for PCB assembly (typically \$1,200 minimum). With component sizes constantly shrinking (i.e. 1.0 x 0.5mm resistors and 0.25mm pitch BGAs), these tolerance for PCB library components are even tighter and better quality control is required.

PCB Layout

Make sure all internal or external resources have experience with technologies in the current design. Otherwise, schedules are at a high risk. Outsource layout services when technologies are new to your company (PCB layout services typically do 100-600 designs/year and see most of the new technology, when it's being developed). Your internal engineers will learn from good layout designers and be able to apply this knowledge to the next design.

PCB Assembly

Most OEMs outsource NPI PCB assembly services (EMS) based on geographic convenience and turnaround times. More sophisticated EMS providers will want to buy the components for your assemblies (turnkey) and have advanced test capabilities. New, or custom, components with long lead times may need to be ordered (internally or through the EMS provider) early in the schematic design part of the project cycle. Almost all designs have special requirements (MIL SPEC, high speed, wireless, medical, etc.), so carefully match the EMS provider with your needs. Feed forward DfX information from the PCB layout design, library creation and PCB fabrication to the assembly operation. This will reduce the chance of mismatch designs that show up as delays in assembly. Flying probe electrical testing after assembly is a good way to ease the transition to full production when lot sizes increase from pure NPI volumes.

PCB fabrication is often included as part of the PCB assembly process. Broad measures of a particular PCB fabricator's capabilities are the maximum number of layers and minimum line width that can be produced. Make sure your design is not at the limit of any of your PCB fabricator's capabilities or unexpectedly poor yields may result (with delays or missed shipments).

Reference Material

ROI Calculator- PCB Libraries (numbers shown for example only)

Avg PCB size	small <4x4"	med~5x10"	big >10x10"
		X	
PCB density	light	avg	dense
		X	
Avg # components	25	100	200
		X	
# new PCBs /year	10		
Avg # revisions/PCB	2		
% new library comps	15%		
In house librarian salary	\$ 60,000	\$/year base	Salary =\$78k w/benefits
# new parts needed /yr=	300	'=100 X 10 X 2	X 0.15
		<u>Total \$</u>	
In house \$/part =	\$ 376	\$ 78,000	= \$78k *1.3 / 300
Outsourced \$/part =	\$ 50	\$ 12,000	= \$50/part avg cost X 240
Outsource \$ savings/yr =		\$ 55,600	= \$78k - \$12.0k

References:

1, 2 – Aberdeen Group White Paper May 03, 2007 “Top Electronic Hardware Design Performers Hit Printed Circuit Board Development”

Industry Web Sites for more information

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| http://www.pcb007.com | I Connect-PCB Design and SMT |
| http://pcdandf.com/cms/home | Printed Circuit Design and Fab Magazine |
| http://www.pcbupdate.com | PCB daily email news |
| http://www.circuitsassembly.com | Circuits Assembly Magazine |
| http://www.smtnet.com/ | Surfact Mount Technology Forums |
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| http://ipc.org/default.aspx | Inerconnects and Packaging Council |

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